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Sustainable Development Strategy for Payang Fisheries at Pasir Baru Fish Landing Base, West Sumatra, Indonesia

[1]Juli Adha, [2]Junaidi, [3]Suparno

[1, 2, 3] Program of Aquatic, Coastal and Marine Resources, Graduate Program,
Faculty of Fisheries and Marine Sciences, Universitas Bung Hatta.
Jl. Sumatera Ulak Karang, Padang 25133, West Sumatera, Indonesia.
Corresponding author: Juli Adha, junaidi@bunghatta.ac.id

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Abstract—Payang fisheries are an important capture fishery activity supporting the livelihoods of coastal communities at Pasir Baru Fish Landing Base, Padang Pariaman Regency. However, the fishery faces several challenges, including dependence on weather and wave conditions, high operational costs, uncertain catch and income, and limited access to formal financing. This study aimed to formulate a sustainable development strategy for payang fisheries at Pasir Baru Fish Landing Base. A survey method was applied using total sampling involving 40 payang fishing units. Primary data were collected through interviews and questionnaires, while secondary data were obtained from relevant institutions. Data were analyzed using multiple linear regression, financial feasibility analysis, and strengths, weaknesses, opportunities, and threats analysis through internal and external factor matrices. The results showed that fishing experience had a positive and significant effect on fishermen's income, while capital and technology had no significant partial effects. The payang fishing business generated a net profit of IDR 62.68 million per year, with a revenue-cost ratio of 1.07, a return on investment of 32.99%, and an investment payback period of 3.03 years. The strategic analysis produced internal and external factor scores of 2.85 and 3.061, respectively, with strategic coordinates of (1.270; 1.175), placing the fishery in Quadrant I. Priority strategies include utilizing fishermen's skills and experience, optimizing the functions of Pasir Baru Fish Landing Base, utilizing government assistance and financing programs, and developing fishermen's cooperatives to strengthen access to finance and support the long-term sustainability of payang fisheries.

Keywords—Payang; fisheries; development; sustainable.

1. INTRODUCTION

Padang Pariaman Regency is a coastal area in West Sumatra Province with an approximately 42.1 km coastline facing the Indian Ocean. This geographical setting supports various fishing activities, including payang fisheries [1].

Capture fisheries in Indonesia, particularly small-scale fisheries, are generally characterized by small- to medium-scale operations, relatively simple technology, limited fishing grounds close to the coastline, and relatively low productivity [2].

Pasir Baru Fish Landing Base (PPI Pasir Baru) in Sungai Limau District is a capture-fishery infrastructure that serves as a landing and marketing location for catches. Its facilities include a harbor basin, navigation channel, mooring and unloading facilities, breakwater, fish auction area, and fish processing unit. These facilities make PPI Pasir Baru an important center of coastal economic activity, particularly for fishers using payang gear.

Payang is a fishing gear used to catch pelagic fish by encircling a fish school and subsequently hauling the net. At PPI Pasir Baru,

the payang net is approximately 200 m long, with a cod-end length of about 7 m and mesh sizes ranging from 1 to 20 inches. Fishing operations are conducted in the morning and afternoon, while hauling the gear involves approximately 9–14 crew members.

Catches are strongly influenced by fishing-ground conditions, season, water conditions, and fish-school availability. In addition, operations require fuel, labor, provisions, and maintenance expenditures, making operating costs an important component of the business cost structure [1]. These conditions indicate the need for an integrated assessment of the economic performance and strategic development of payang fisheries at Pasir Baru.

The present study therefore aimed to formulate a sustainable development strategy for payang fisheries at Pasir Baru Fish Landing Base by assessing financial feasibility, identifying factors affecting fishermen's income, and determining the strategic position and priority development strategies.

2. MATERIALS AND METHODS

2.1 Study Location and Period

The study was conducted at Pasir Baru Fish Landing Base, Sungai Limau District, Padang Pariaman Regency, West Sumatra Province, Indonesia, from June to August 2025.

2.2 Data Collection

A survey method was used. Primary data were obtained through direct interviews with payang fishers using structured questionnaires, while secondary data were obtained from relevant agencies, including the Department of Marine Affairs and Fisheries and Statistics Indonesia. Total sampling (census) was used because the number of payang fishing units was limited and accessible. A total of 40 payang fishing units were included, with respondents consisting of skippers and/or business owners. Please do not revise any of the current designations.

2.3 Data Analysis

2.3.1 Multiple Linear Regression

Multiple linear regression was used to examine the relationship between fishermen's income and capital, technology, and work experience. The model was expressed as:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + e \quad (1)$$

where Y is fishermen's income; b_0 is the intercept; b_1, b_2, and b_3 are the regression coefficients for capital, technology, and work experience, respectively; X_1 is capital; X_2 is technology; X_3 is work experience; and e is the error term. The F-test was used to determine the simultaneous effect of the independent variables, while the t-test was used to determine their partial effects.

2.3.2 Financial Feasibility Analysis

Business feasibility was evaluated using net profit, the revenue-cost ratio (R/C), return on investment (ROI), and payback period (PP). Net profit was calculated as:

$$\pi = TR - TC \quad (2)$$

The revenue-cost ratio was calculated as:

$$R/C = TR / TC \quad (3)$$

ROI was calculated from the ratio of net profit to initial investment, expressed as a percentage, while PP was calculated from the ratio of initial investment to annual net profit.

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2.3.3 SWOT Analysis

SWOT analysis was used to formulate development strategies by identifying internal factors consisting of strengths and weaknesses and external factors consisting of opportunities and threats. Internal factors were evaluated using an Internal Factor Analysis Strategy (IFAS) matrix, while external factors were evaluated using an External Factor Analysis Strategy (EFAS) matrix. The resulting factors were then used to construct SO, WO, ST, and WT strategy alternatives.

3. RESULTS AND DISCUSSION

3.1 Characteristics of Payang Fishing Gear

The payang gear used at PPI Pasir Baru consists of a net body, wings connected to a conical body, and hauling ropes. The total net length is approximately 200 m, while the cod-end is about 7 m long. Mesh sizes range from 1 to 20 inches, with a relatively fine mesh in the cod-end. Fishing operations are conducted from approximately 03:00 to 10:00 WIB in the morning and from 16:00 to 20:00 WIB in the afternoon.

Fishing grounds are influenced by oceanographic factors such as water temperature, salinity, currents, and depth, as well as ecological factors including fish habitat, movement patterns, and suitable fishing times. The fishing grounds are generally located relatively close to the coast or in productive waters without coral reefs. The main catches consist of small pelagic fish such as scads, Indian mackerel, sardines, and other small pelagic species. Catch volume is strongly influenced by fishing-ground conditions and the concentration of fish around fish aggregating devices.

3.2 Financial Performance of Payang Fisheries

The analysis showed that a payang fishing business required an initial investment of IDR 190,000,000, generated annual revenue of IDR 990,000,000, and incurred annual production costs of IDR 927,320,000. The difference between revenue and costs resulted in a net profit of IDR 62,680,000 per year. The financial indicators are presented in Table I.

Table 1. Financial Indicators Of The Payang Fishing Business

Indicator	Value
Initial investment	IDR 190,000,000
Total revenue/year	IDR 990,000,000
Total production cost/year	IDR 927,320,000
Net profit/year	IDR 62,680,000
R/C ratio	1.07
ROI	32.99%
Payback period	3.03 years

The annual net profit represented approximately 6.33% of total revenue. With 180 fishing trips per year, the average profit was approximately IDR 348,222 per trip. This indicates that the business was able to cover its production costs, but the margin between revenue and costs remained relatively limited. Therefore, cost efficiency and increased catch productivity are important for maintaining profitability.

An R/C ratio of 1.07 indicates that every IDR 1.00 spent generated IDR 1.07 in revenue. An R/C ratio greater than one indicates that the business generated revenue exceeding its costs. The ROI of 32.99% indicates that the IDR 190,000,000 investment generated a net profit of IDR 62,680,000. The PP of 3.03 years indicates that the initial investment could theoretically be recovered in approximately three years if the profit level is maintained. Overall, the financial indicators show that payang

fishing remains economically feasible, although its relatively narrow margin makes the business sensitive to increases in operating costs or declines in catch volume.

3.3 Factors Affecting Fishermen's Income

The simultaneous test produced an F-value of 5.491 with a significance level of 0.003, indicating that capital, technology, and work experience jointly had a significant effect on fishermen's income. The coefficient of determination (R^2) was 0.314, indicating that 31.4% of the variation in income was explained by the three independent variables, while the remaining variation was attributable to other factors.The partial regression results are presented in Table 2.

Table 2. Multiple Linear Regression Results For Fishermen'S Income

Variable	Coefficient	Sig.	Interpretation
Capital	0.0566	0.7328	Not significant
Technology	0.2666	0.0950	Not significant
Work experience	0.3455	0.0221	Significant

Capital did not have a significant partial effect on income. This indicates that an increase in capital does not necessarily translate directly into higher income when capital is not used effectively. Technology likewise did not show a significant partial effect in the present analysis.

In contrast, work experience had a positive and significant effect on income. This finding indicates that experience is an important factor in payang fishing. Fishers with longer experience may have better knowledge of water conditions, fishing grounds, operating times, and fishing techniques. This result is consistent with previous studies reporting positive relationships between fishing experience and fishermen's income [4], as well as between fishing experience and catch production [3].

The finding implies that development strategies should not focus solely on increasing capital and technology but should also strengthen human-resource capacity. Fishermen's experience can be developed through training, intergenerational knowledge transfer, and improved capacity to use information supporting fishing activities.

3.4 SWOT Analysis of Payang Fisheries

The development strategy was formulated by identifying internal and external strategic factors. Internal factors consisted of strengths and weaknesses, while external factors consisted of opportunities and threats. The factor scores are presented in Table 3.

Table 3. Summary Of Internal And External Strategic Factors

Strategic factor	Score
Strengths	2.061
Weaknesses	0.792
Total IFAS	**2.853**
Opportunities	2.118
Threats	0.943
Total EFAS	**3.061**

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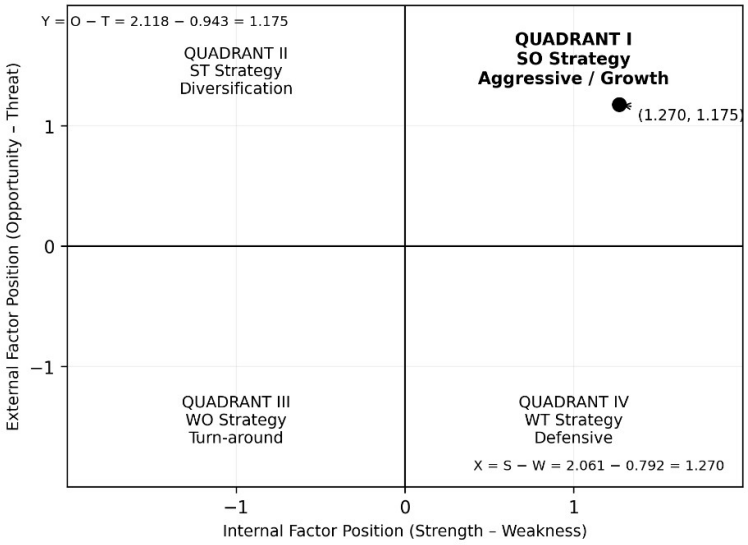
Based on the results of the internal and external strategic factor analysis, the strategic position of the payang fishery was determined using the SWOT diagram. The analysis produced coordinates of (1.270; 1.175), indicating that the payang fishery is positioned in Quadrant I, which represents an aggressive growth strategy (SO). The SWOT strategic position is presented in Figure 1.

Fig. 1. SWOT strategy position of payang fisheries at Pasir Baru Fish Landing Base.



The SWOT position in Quadrant I indicates that the payang fishery has internal strengths that can be utilized to take advantage of available external opportunities. Therefore, the development strategy is directed toward a Strength–Opportunity (SO) strategy, while ST, WO, and WT strategies are also formulated as alternative strategies to address potential threats and weaknesses. The resulting SWOT strategy matrix is presented in Table 4.

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Table 4. Swot Strategy Matrix For Sustainable Development Of Payang Fisheries

INTERNAL / EXTERNAL FACTORS	OPPORTUNITIES (O)	THREATS (T)
STRENGTHS (S)	SO1. Use fishermen's skills and experience in operating payang to increase productivity and meet demand for fish consumption. SO2. Optimize PPI Pasir Baru for landing, marketing, and fishery activities to expand catch marketing. SO3. Utilize the effectiveness of payang gear and available vessels through assistance and financing programs to increase fishing capacity. SO4. Develop fishermen's cooperatives by utilizing existing experience and institutions to strengthen financing access and business sustainability.	ST1. Use fishermen's skills and experience to adjust fishing operations to weather and wave conditions. ST2. Improve vessel and gear operating efficiency to reduce the impact of increasing fuel prices on operating costs. ST3. Improve the effectiveness of payang gear and catch quality to strengthen competitiveness with other fishing gears. ST4. Optimize PPI Pasir Baru for catch marketing and distribution to reduce the impact of fish-price fluctuations.
WEAKNESSES (W)	WO1. Utilize government assistance and financing programs to reduce limited access to formal financing. WO2. Develop fishermen's cooperatives as an alternative financing source for capital and operating-cost needs. WO3. Optimize PPI Pasir Baru and high demand for fish consumption to strengthen marketing and reduce income uncertainty. WO4. Utilize fisheries programs to improve fuel-use efficiency and fishermen's capacity to deal with uncertainty.	WT1. Improve fishing-operation scheduling based on weather information to reduce risks from bad weather and high waves. WT2. Improve fuel-use efficiency and operating-cost management to anticipate fuel-price increases. WT3. Diversify marketing channels and strengthen access to price information to reduce income uncertainty and fish-price fluctuations. WT4. Strengthen fishermen's institutions and cooperation to improve financing access and the ability to face business competition.

The analysis showed an internal factor score of 2.85 and an external factor score of 3.11. Strengths were greater than weaknesses, while opportunities were greater than threats. Based on the SWOT coordinate calculation, the strategic position was located in Quadrant I at approximately (1.270; 1.175). This position indicates that payang fisheries have internal strengths

that can be used to take advantage of external opportunities.

The Quadrant I position supports a growth-oriented strategy based on the Strength–Opportunity (SO) approach. Similar SWOT applications have identified Quadrant I as a strategic position in which internal strengths and external opportunities can be maximized for business development [5]–[7].

3.5 Sustainable Development Strategies for Payang Fisheries

3.5.1 Improving productivity through fishermen's experience and skills

Fishermen's skills and experience are important strengths that can be utilized to improve fishing productivity. The regression results reinforce this finding because work experience had a significant effect on income. Fishing experience has also been identified as a production factor in catch analysis [3]. This strategy can be implemented through capacity building, transfer of knowledge from experienced fishers to younger generations, and improved ability to determine appropriate fishing times and locations. In this way, accumulated fishing experience becomes an asset supporting the continuity of the business.

3.5.2 Optimizing the functions of Pasir Baru Fish Landing Base

PPI Pasir Baru is an existing infrastructure asset that can be utilized to improve catch marketing and post-landing handling. Optimization can include improved landing services, marketing, catch handling, and linkages between fishers and other fishery businesses. Previous research on fish landing bases has also shown that such facilities are designed to serve fishing-vessel activities and fishery-product marketing [8]. Strengthening these functions is expected to improve marketing-chain efficiency and the economic position of fishers.

3.5.3 Utilizing assistance and financing programs

Government assistance and financing programs can support business capacity, particularly for the maintenance or procurement of production facilities. The use of more efficient fishing technology may help fishers locate fish resources, reduce search time, and lower operating costs [9]. However, because capital did not have a significant partial effect on income in this study, financing should be accompanied by stronger business-management capacity. Increasing capital without improving efficiency may not necessarily increase income.

3.5.4 Developing fishermen's cooperatives

Fishermen's cooperatives can strengthen access to financing, production inputs, information, and markets. Collective procurement of inputs and collective marketing of catches can improve fishermen's bargaining position. The development of fishermen's cooperatives therefore has a broader institutional sustainability dimension [10]. Cooperatives should not be limited to savings and lending functions but should also serve as economic institutions supporting the continuity of payang fishing businesses.

3.6 Implications for Sustainability

The results indicate that payang fisheries remain economically feasible, but the profit margin is relatively limited. Annual net profit of IDR 62,680,000 represented approximately 6.33% of total revenue. This condition suggests that development should be implemented cautiously.

Development should not rely solely on increasing the number of fishing trips or fishing capacity. More appropriate priorities are improving cost efficiency, catch productivity per trip, catch quality, and the economic value of landed fish. The experience of fishers, optimization of PPI Pasir Baru, improved access to financing, and stronger cooperative institutions can collectively support not only higher income but also the long-term economic resilience of fishing communities.

IV.CONCLUSION

Payang fisheries at Pasir Baru Fish Landing Base remain financially feasible, with annual net profit of IDR 62.68 million, an R/C ratio of 1.07, ROI of 32.99%, and a payback period of 3.03 years. Work experience had a positive and significant effect on fishermen's income, whereas capital and technology did not have significant partial effects. SWOT analysis placed the fishery

in Quadrant I, indicating that internal strengths can be used to capture external opportunities. Priority strategies include utilizing fishermen's skills and experience to improve productivity, optimizing PPI Pasir Baru as a landing and marketing center, utilizing assistance and financing programs to strengthen production capacity, and developing fishermen's cooperatives to improve access to finance and institutional support. Implementation should be accompanied by operating-cost efficiency, mitigation of weather and price risks, and improved catch quality so that economic development of payang fisheries can proceed sustainably.

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